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Discussion of Fabio Milani, "Learning and Time-Varying Macroeconomic Volatility."

James Bullard

President and CEO
Federal Reserve Bank of St. Louis

27 June 2008, Frankfurt am Main

International Research Forum on Monetary Policy

ECB, FRB, CGES, CFS

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- Widespread agreement on the nature of the great moderation in the U.S.
  - The volatility of HP-filtered real output fell by about 1/2 after 1984.
  - Volatility of many other macroeconomic variables also fell significantly.
- Explanations.
- This paper focuses on the third possibility.

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  - Better monetary policy.
  - Structural change.
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Learning mechanism

- Replace rational expectations with learning.
- Learning takes place via recursive algorithms.
  - With expectational stability, equilibrium will still be REE.
- Suppose agents suspect structural change.
- Large shocks may indicate structural change is occurring.
- Agents discount past data more.
- Decisions are based on recent, volatile data.
- This increases volatility still further.

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- Standard learning via recursive algorithms.
- Critical: Time-varying gain.
- Estimate using Bayesian methods.

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- Model can generate time-varying volatility.
- Right order of magnitude to contribute to explaining the great moderation.
- Standard naive econometric exercise would wrongly conclude shock volatility has declined.
- The time-varying volatility is endogenous.

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- Relatively standard NK model.
- Three shocks, including a monetary policy shock.
- Monetary policy is a Taylor-type rule with inertia.
- Preference and sticky price parameters are constant.
- Inertia parameter and policy parameters are time-varying.
- Policy rule is operational in the sense of McCallum.
- Shock innovations have constant variance.

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- Replace the RE assumption with learning.
- Agents have a perceived law of motion that corresponds to the REE.
- They update coefficients in the PLM using standard recursive algorithms.
- Importantly, the gain is time-varying:

$$g_{t,y} = \begin{cases} t^{-1} & \text{if } \frac{\sum_{j=0}^{J}(|y_{t-j} - E_{t-j-1}y_{t-j}|)}{J} < v_t^y \\ \bar{g}_y & \text{if } \frac{\sum_{j=0}^{J}(|y_{t-j} - E_{t-j-1}y_{t-j}|)}{J} \geq v_t^y \end{cases} \quad \text{for}$$

$y = \pi_t, x_t, i_t$.

- Reasonable? Something more continuous?

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- Calibrated case, with large gain threshold.
- Clear evidence of volatility clustering, even though the innovation variances are constant.
- If there were no switching in the gain, there would be no volatility clustering.
- Reasonable?
- "Times of great uncertainty and large shocks are also times when past data is discounted most heavily."

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- Bayesian methods allow joint estimation of structural and learning parameters.
- $J = 4$, window of one year, results not too sensitive to this.
- Gain parameters are relatively high in volatile periods.
- Taylor principle is satisfied.
- Simulation with estimated parameters: 10,000 samples of 185.
- Time-varying volatility.

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- Bayesian methods allow joint estimation of structural and learning parameters.
- $J = 4$, window of one year, results not too sensitive to this.
- Gain parameters are relatively high in volatile periods.
- Taylor principle is satisfied.
- Simulation with estimated parameters: 10,000 samples of 185.
- Time-varying volatility.

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  - Inflation s.d. ratio 0.39 versus 0.35 in the data.
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  - Interesting. These ratios would be unity without the gain changes.

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What a standard econometric analysis would find

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- More standard econometrics tends to argue for the "less frequent and smaller shocks" explanation.
- This paper has some endogenous interaction between shocks and decisions of agents.
- Large shocks cause agents to react more aggressively to incoming data.
- It is a good idea.

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- Many feel that recursive learning should be Bayesian.
- Bullard and Suda (2008).
- Standard recursive learning exercise, but replace classical econometricians with Bayesian econometricians.
- Main results still hold:
- *Stability still an issue.*

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- Main results still hold:
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- Very nice paper in a very nice conference.
- This paper has a compelling endogenous explanation for clustered macroeconomic volatility.
- I think further research and exploration of this idea is warranted.
- Important implications for how we perceive the role of stabilization policy.
- Stabilization policy keeping agents within thresholds produces an extra measure of volatility reduction.

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